BUSINESS WEEK
NOV 19 1955
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QUOTES ON SOVIET SCIENTISTS:

"All of us were impressed by the disturbing fact that Russia appears to be training scientists and engineers at a faster rate than we are."
1955: Lewis Strauss

"The Soviet scientist and engineer is deeply suspected by the Party. His vital technical skills give him a power potentially challenging the Party's absolutism."
1955: Demitri B. Shimkin
U. S. Dept. of Commerce

"If you continue to educate the Russian people, Mr. Stalin, the first thing you know you'll educate yourself out of a job."
1942: Wendell Willkie

"Their top scientific men appear to be the equal of the top men in the West though they have fewer of them, level for level. If we take a longer look we can foresee the possibility of great changes in the Soviet system. The educational advances will play a major part. There is already evidence of this . . . the physical sciences are being freed of party-line restraints."
1955: Allen W. Dulles

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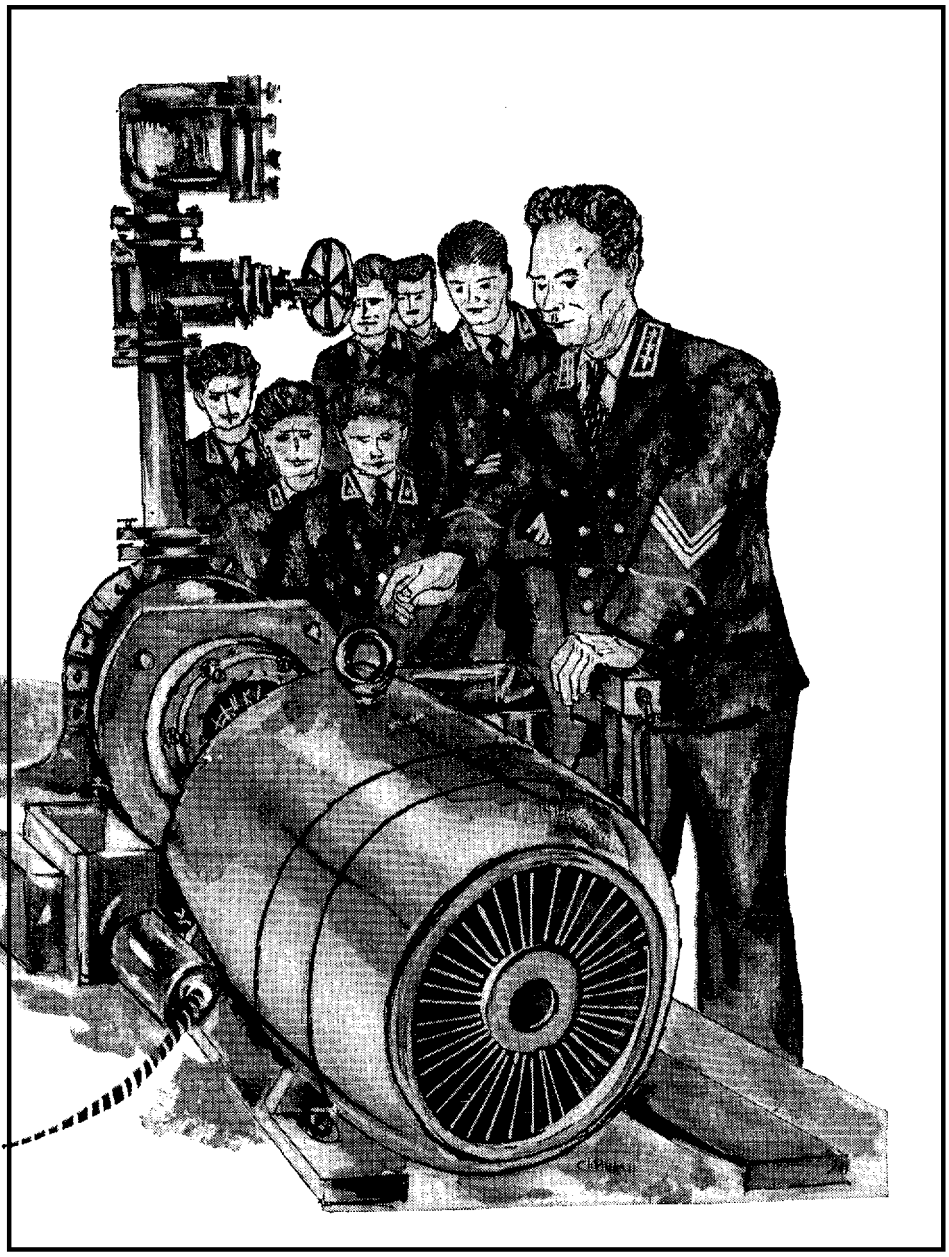

Man Behind the Soviet Challenge

Bright little boys in Russia want to be engineers and scientists. These are the prize professions. Engineers and scientists may drive cars and own summer homes in the country. They get relatively good pay. And, for them, political risks are small.

Of course, these pleasant things would not be available for Russian scientists and engineers if the Kremlin didn't want it that way. Years ago, the Soviet leaders recognized that if they were to transform Russia into an industrial nation they would have to produce skilled technical men to make the industry go.

By the early 1930s their drive to train these men was under way. More and more technicians were trained each year—until last year the Soviet Union's 177 engineering schools graduated some 53,000 engineers. That is more than the U.S. has ever graduated in any year, and more than twice as many as were graduated in the U.S. last year.

• **Job for the Future**—This gap in numbers between Russia and the U.S. undoubtedly will widen still further in the next few years. Russia's present rulers are continuing the drive to train more and more engineers. In recent speeches they have stressed their determination to (1) keep abreast the U.S. in the new

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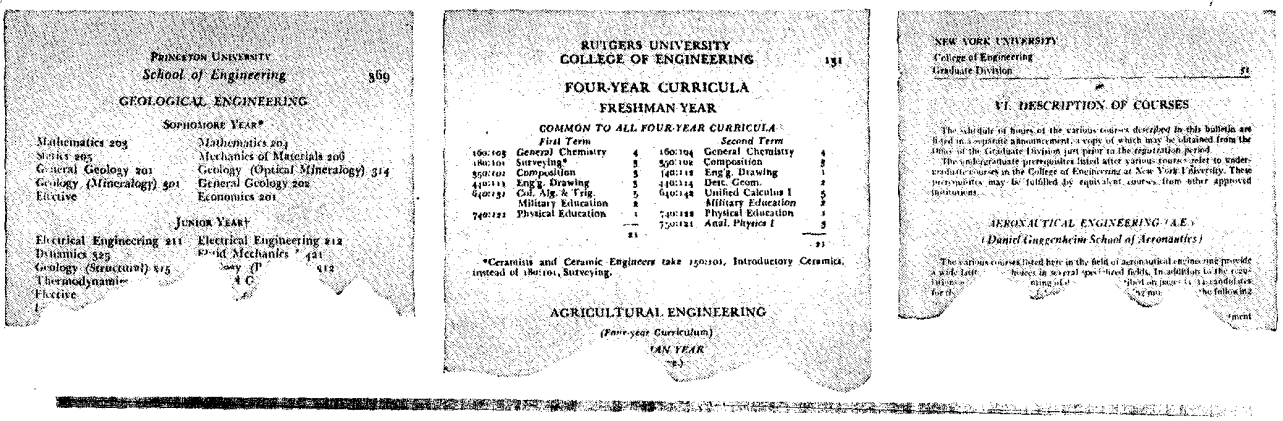
IF YOU THINK U.S. EDUCATION IS TOO SPECIALIZED . . .



PRINCETON UNIVERSITY
School of Engineering 869

GEOLOGICAL ENGINEERING

SOPHOMORE YEAR*

Mathematics 203	Mathematics 204
Statics 205	Mechanics of Materials 206
General Geology 201	Geology (Optical Mineralogy) 314
Geology (Mineralogy) 301	General Geology 202
Elective	Economics 201

JUNIOR YEAR†

Electrical Engineering 211	Electrical Engineering 212
Dynamics 325	Fluid Mechanics * 321
Geology (Structural) 315	Geology (P 412
Thermodynamics	4 C
Elective	

RUTGERS UNIVERSITY
COLLEGE OF ENGINEERING 131

FOUR-YEAR CURRICULA

FRESHMAN YEAR

COMMON TO ALL FOUR-YEAR CURRICULA

First Term			*Second Term*	
160:105	General Chemistry	4	160:104 General Chemistry	4
180:101	Surveying*	3	350:102 Composition	3
350:101	Composition	3	140:111 Eng'g. Drawing	1
140:113	Eng'g. Drawing	3	440:114 Descr. Geom.	2
640:131	Col. Alg. & Trig.	5	640:132 Unified Calculus I	5
	Military Education	R	Military Education	R
740:121	Physical Education	1	740:122 Physical Education	1
		21	750:121 Anal. Physics I	3
				21

*Ceramics and Ceramic Engineers take 150:101, Introductory Ceramics, instead of 180:101, Surveying.

AGRICULTURAL ENGINEERING

(*Four-year Curriculum*)

FAN YEAR

NEW YORK UNIVERSITY
College of Engineering
Graduate Division 51

VI. DESCRIPTION OF COURSES

The schedule of hours of the various courses described in this bulletin are listed in a separate announcement, a copy of which may be obtained from the office of the Graduate Division just prior to the registration period.

The undergraduate prerequisites listed after various courses refer to undergraduate courses in the College of Engineering at New York University. These prerequisites may be fulfilled by equivalent courses from other approved institutions.

AERONAUTICAL ENGINEERING (A.E.)

(*Daniel Guggenheim School of Aeronautics*)

The various courses listed here in the field of aeronautical engineering provide a wide latitude in choices in several specialized fields. In addition to the courses listed on page [illegible] the following

ment

TAKE A LOOK AT THIS . . .

A qualified young man in USSR wants to be an engineer. In USSR, it is usually a 5½-year program. By time he has completed his course, he will have narrowed his field in this way:

1. He picks one of 24 engineering fields.

2. Say he chooses metallurgy. Here he must decide on one of 10 metallurgical specialties — nonferrous, blast furnaces, rolling technology, etc.

3. Say he chooses nonferrous metals. Here he must select one of 11 fields — copper & alloy metallurgy, precious metals refining & metallurgy, etc.

4. Say he chooses copper & alloys metallurgy. Then he must decide whether to specialize in refining & smelting technology, or primary processing, or one of several other sub-specializations.

When this metallurgical engineer finishes his training, he receives a diploma in his chosen sub-specialty. He is then assigned to a job.

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technological and scientific revolution, and (2) overtake the U.S. in total industrial production.

Obviously, the job of making good the Kremlin's determination falls on the new engineers who are being graduated from Soviet schools in constantly growing numbers.

So for the West, as well as for Russia, the Soviet engineer is an important man. What kind of a man is he? How does he compare in skill with, say, a graduate of MIT or Cal. Tech? What kind of a Communist does he make?

• **Mystery Man**—To all but a few people in the West, the quality of Soviet engineering education is a mystery. Except for an occasional remark, from someone like Allen W. Dulles, head of the U.S. Central Intelligence Agency—"Soviet mathematics appears to be clearly on a par with the West, and even ahead in some respects"—or from Pravda—"The extensive narrowness of specialization will have to be eliminated in the immediate future"—Western educators and industrial leaders know very little about the Russian technical man. Certainly, there is too little information in print to make comparison possible between a crewcut American, with a B.S. degree from Carnegie Tech, and an engineer who did his undergraduate work at Moscow's Institute of Aeronautical Engineering.

Two years ago, the National Academy of Sciences-National Research Council recognized the need for detailed information on the quality and supply of Soviet professional manpower. It decided to have a study made.

I. Opening the Veil

This week, the result of that study was published by the National Science Foundation. Under the title of Soviet Professional Manpower: Its Education, Training and Supply, by Nicholas De Witt, it gives the West its first real look at today's Soviet engineer.

Other studies are under way, too. Massachusetts Institute of Technology's Center for International Studies is also at work evaluating Russian education methods. It is delving deep into the quality of Russian textbooks and into

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the Soviet passion for specialization in industrial training. The State Dept., too, has been studying these subjects.

But DeWitt's effort is the most comprehensive uncovering yet available of how Russia trains and deals with its professional manpower.

• **First-Hand Knowledge**—Author DeWitt is of Russian background. He studied several years in an engineering school in Russia, knows plenty about Russian education. He is currently completing work for his doctorate at the Russian Research Center at Harvard.

In his study, DeWitt does not attempt to compare the Russian engineer and the American in terms of who is the better man for the job. Such a comparison is impossible, he says, because conditions under which each works are completely different. This fact alone makes the judging of performance, particularly in some technical fields—just a matter of specula-

Instead, he makes his comparisons at the academic level. Which program—Soviet or American—is more comprehensive? Which is more specialized?

• **Narrow Aim**—In DeWitt's view, there is no doubt: The Russian engineering student works harder. He spends about twice as much time in class or lab in his 5½ years of study as does the American student in his four years of undergraduate work. Toward the end of his training, the Russian is squeezed into a very narrow specialty. At graduation time, he is not merely a mechanical engineer. He is a mechanical engineer with a diploma that certifies him for agricultural machinery, or a power engineer with a specialty in hydroelectric stations.

Planned Incentives

But DeWitt's book is a summation of the Russian attitude on education. The Soviet state, he says, has little use or sympathy for people who know everything in general, but little in particular. Its entire education system is set up to produce specialists, particularly specialists in narrow fields of science.

Preparation starts early. By the time a young Russian has completed the equivalent of high school education, he is exposed to more math and science than many American high school students will tolerate. More than 40% of his instruction in the upper grades is in math and science. Young Russians who have a yearning for literature or a social science are out of luck. They take the math and science, too.

By contrast, an American student preparing for a career in science is likely to devote no more than 25% of his classroom time in high school to

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[illegible]

of a [illegible] and spend only 5% of his school [illegible]

[illegible]

monthly allowance. Those with exceptional records get bonuses. Probably the biggest [illegible] for an engineer or a scientist is prolonged deferment, even exemption, from military service through his student years. Sometimes this extends through his early professional life, too.

Later the rewards get bigger. Salaries of research scientists and engineers are close to the top. The government often gives its successful scientists and engineers homes in the country and spacious apartments. (Physicians have no comparable prestige. Nor do economists—and their paths are cluttered with political risks.)

So it's no wonder that last year, according to a Soviet announcement, Russian engineering and science schools received seven acceptable applications for every vacancy [illegible]

[illegible] would make [illegible] educator shudder.

DeWitt's main criticism is that the textbooks [illegible] teach the Russian student the principles [illegible] attempt to do his thinking for him. In that way they are more handbooks than textbooks.

• **Straitjacket Thinking**—DeWitt's real criticism is that this education-by-rote discourages the student from breaking away from tradition. He thinks within the limits of the book. It should be noted, however, that some U.S. engineering schools have been criticized for using the same approach in certain fields.

The MIT study group is not so critical of Russian textbooks. In its preliminary reports it says the best available evidence suggests that the quality of Russian technical education [illegible]

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"Judging strictly on technical grounds, one must conclude that high-quality scientific education seems to be taking place."

IV. The Long Grind

Whatever the quality, the pressure is certainly hard. For Russian engineering students there is no such thing as a bachelor's degree. The Russian graduate receives a diploma that states that he is a chemist or a mechanical engineer.

The school year runs longer for the Russian—from Sept. 1 to July 1—with only a few holidays. He is in school 32 weeks a year (about the same as in the U. S.) but he spends an extra four weeks a year taking exams. His school week is longer—six days. And each day is perhaps a shade longer than in most U. S. engineering schools. Class and lab hours for most Russian students are between 32 and 40 hours a week.

The Soviet engineering student's program of study is broken into three parts. His first two years are devoted primarily to science and engineering fundamentals. The next year-and-a-half he spends in advanced engineering courses in his specialty field. He gives a further 18 months to training in a narrow specialization. In his last six months he works on his thesis.

• **The Practical Side**—In summer, the young Russian student goes to work. During the summer, between his second and third years, he is assigned to his first job—for about five weeks—in a plant that employs the kind of engineer he is intending to be. There, he is pretty much an observer. He is paid the prevailing wage rate for a semi-skilled worker, probably around 500 to 600 rubles ($125 to $150 at the unrealistic, official rate) a month.

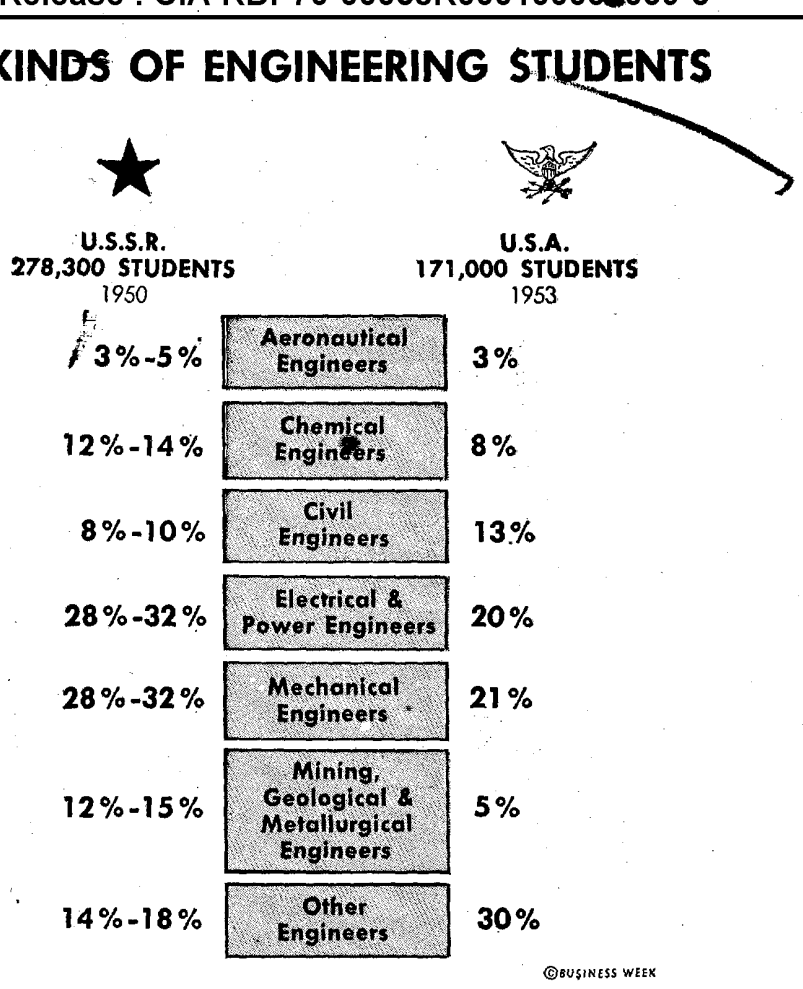
The following summer, his job responsibility increases. He works longer, usually for 10 weeks. In his last summer, between his fourth and fifth years, he might be assigned as the assistant to the shop superintendent. His pay will be higher, probably around 800 rubles a month.

These sessions of summer work are compulsory for engineering students in Russia. But most students look forward to it: It gives them a chance to travel.

V. The Super Specialists

Last year's end product of the Soviet's engineering schools—those 53,000 newly graduated engineers—cannot be shrugged off. They are well-trained men and women. (About 20% of them are women.) In many fields, says De Witt, there can be no doubt that Russian engineering training is quite comparable to that of the U. S.

The scholastic competition is hot.



You get an indication of that in the recent statement made to students at the University of Moscow. In so many words, the students were told: Those of you who do well here will go into scientific research. The others will teach high school.

• **Tailored for Jobs**—But what really stands out as the greatest distinguishing feature of Soviet engineering education is its heavy concentration on narrow specialties. At school, the undergraduate is fitted into one of more than 500 sub-specialties. Western educators abhor such attempts to tailor young men and women for specific jobs. A number of American engineering schools have swung in just the opposite direction in recent years. They tend to aim for non-specialization. Some U. S. engineering schools have abandoned elective courses in specialty subjects in certain departments. Instead, they substitute more general and theoretical engineering courses (BW—May21'55,p64).

Some of the courses offered in Russian engineering schools illustrate this narrow concentration: Mechanical Equipment of Cement Industries, Technology of the Macaroni Business, Uses of Machinery and Electricity in Animal Husbandry.

• **All for the Plans**—The Russians' aim here is to fill new jobs with men qualified to handle them on the day they start work. In a planned economy—or so the theory goes—you can determine today precisely how many copper smelting engineers you will need five years hence. In the engineering schools, you see to it that enough students are enrolled in the copper smelting courses to meet demand five years hence.

But plans often change. Malenkov's emphasis on consumer goods, then the reversal back to producers' goods when he stepped down, is said to have caused a lot of trouble at the schools. Even in a planned economy, it seems to be true that this year's estimate of some future year's demand for engineers of a specific type is more likely to be wrong than right.

• **When Plans Change**—The result is frequently ludicrous: a graduate engineer comes into a plant in the Urals. He has been sent by Moscow, specifically trained to fill a vacancy as a power generation engineer. But when he arrives, he is told that the plant needs no power generation engineer. One year ago the plant foresaw that this engineer would be needed. But now it needs a man who has been trained in electric motors. Only the exceptionally adaptable man will be willing to switch fields at this point. Most young men, under

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STRUCTURE OF GRADUATING CLASSES

	ENGINEERING	AGRICULTURE	HEALTH & MEDICAL SCIENCES	OTHER FIELDS
U.S.S.R. 1954 173,000 Total	[illegible]	18,000	24,000	78,000
	30.6%	10.4%	13.9%	45.1%
U.S.A. 303,000 Total	[illegible]	[illegible]	[illegible]	[illegible]
	7.3%	3.3%	7.6%	81.8%

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those circumstances, would go back to Moscow for a new assignment.

Some U.S. educators believe that the narrow specialization within the Soviet system will stifle technological advance. Specialization during an engineer's school years may slow, even stall, development of creative engineering talent. It could make for an engineer's lack of confidence when faced with a problem outside his own small field.

However, this will not always hold true. The Russian engineer does receive a strong education in the fundamentals of science and engineering in his first couple of years of training.

• **Complaints at Home**—There is evidence that some groups in Russia strongly oppose narrow specialization. Pravda has blasted it. So have certain scientific journals.

But DeWitt and others believe that the opponents want only to trim the specialties from around 500 to maybe 300—still far more than U.S. educators would tolerate.

The pressure for specialization within Russia comes from industry. The plants cry for specialists. The educators are its foes. This situation is strikingly parallel to that in the U.S., though here it applies to a far less serious degree.

VI. The New Graduate

When graduation time comes round, the current yearly crop of 53,000 new engineers prepares to move into the huge Soviet industrial system. If the system is functioning properly, each will find a niche somewhere. But frequently the system is not working properly. And so the result is the chronic shortage of skilled manpower for high-priority industries. In 1952, for instance, the Soviet Ministry for Heavy Industrial Construction could find men with practical training for only 61% of its engineering posts.

A lot of these shortages are caused by changes of planning within the Soviet economic system. But the new graduates contribute to the shortages of manpower, too. All try to fill posts in urban centers in western Russia. Though there's a strong demand, few want to venture to Siberia to help pioneer its industrial growth.

Placement is compulsory for most graduates. The top students have more choice, of course.

• **More Favors**—The poorest paid new engineer earns 900 rubles ($225) a month. This is roughly comparable to the national average for all salaried workers and employees. But it is higher than the new school teacher's pay (650 rubles a month) or that of the new physician (800 rubles a month).

A good aeronautical engineer earns 1,100 or 1,200 rubles a month from the start. A "so-so" Russian engineer will make up to 1,000 rubles a month at the end of his first year. His salary will move up by about 6% each succeeding year.

If he has ability, he will find a supervisory job before his first year is up. With the new job will go a salary boost of 50%. DeWitt says that such a move is not uncommon.

Civil engineers, such as those who made the recent junket to look at U.S. housing (BW—Oct.15'55,p30) reported their salaries at 4,000 to 5,000 rubles a month. Russian engineers—with say, 15 years' experience—can make as much as 2,500 rubles a month.

• **Talent's Reward**—The reason that big jumps in pay—and position—are so common is due mainly to the Soviet system's great need for management talent. There are few schools that train men for management, and few non-

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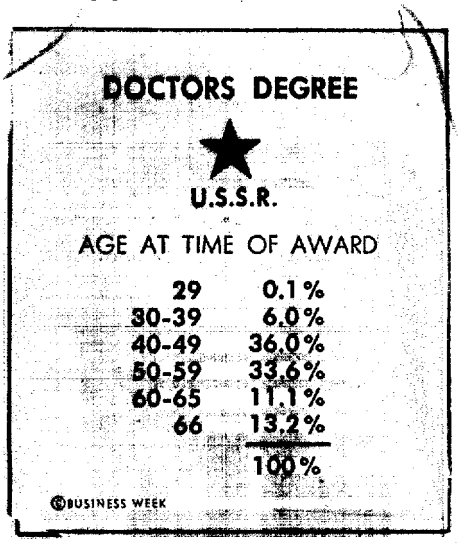

engineers & scientists move into important positions in industry. So management talent must come from within the engineering ranks.

• **Fast Steppers**—The engineers who move fastest within the Soviet system are those who can show that they have met production goals successfully. A good cost-cutter is pretty certain to move fast.

Of course, there is no room for sales engineers, because distribution in a socialistic economy is supposed to take care of itself. Thus, the producers are the heroes. And, in most instances, the producers are engineers.

• **Trapped in the System**—A young engineer who dislikes his job has a tough time getting away from it. Disgruntled engineers are not uncommon, because only a few graduates can choose their jobs.

If the engineer dislikes his field, he is in real trouble, because the system frowns on engineers switching from one field to another. If he merely wants to move from one job to another—within the same field—it's tough enough. He can't just go and apply. He has to have a work book.

A work book is a sort of an industrial passport. It was introduced in the 1930s, ostensibly as a social security record keeper. Actually, its purpose was to cut down the staggering labor turnover within industry, which, at that time, was running at 100%—on the average, each worker changed his job once a year. The Russian cannot get a work book unless he is dismissed from his job. In theory, a prospective employer cannot talk to him unless he

affairs. In his technical papers, the engineer is careful to say the diplomatic thing when introducing new concepts.

Throughout his professional life, the Russian engineer spends little time [illegible] years. During his school years, only about 7% of his time goes for political indoctrination and socio-economics. The non-science student gets [illegible] dose.

• **No Room for Error**—There is no pat answer to the question of party loyalty among engineers and scientists. Statistics on party membership are not an infallible barometer of political thinking. They show, for instance, that about 88% of all Soviet undergraduates are members of the Young Communist League. They show, too, that only 40% of Soviet engineers belong to the Communist Party. But you cannot conclude from that that as Russian engineers grow older and wiser, their belief in Communism dwindles.

In fact, the Russian engineer is, by his education, an extremely narrow personality; he spends no time at all at liberal arts during his college years.

[illegible] interviews with refugees from Russia has found what the result of this narrowness can mean. He has he found a basic belief in the Communist system firmly planted in the refugees. Though they fled from the terrors of Russian Communism, their belief in the economic theories of Com-

Reds With Slide Rules

[illegible] says that the Communist [illegible] suspicious of the Russian [illegible] there are [illegible] controls on his day-[illegible] might be that [illegible] from party

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